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(54) **Intrinsically antistatic thermoplastic resin compositions.**

(57) Thermoplastic resin compositions comprising 1 to 40 wt % a polyether ester amide (A) and 99 to 60 wt % of at least one thermoplastic resin (B) selected from styrene based resins, polyphenylene ether resins and polycarbonate resins are disclosed. These are permanently antistatic and in preferred forms are excellent in mechanical properties represented by impact resistance, heat resistance, moldability and also in the appearance and gloss of the moldings, and are suitable for housing of optical or magnetic recording media.

**Title:      Intrinsically Antistatic Thermoplastic Resin  
             Compositions**

Synthetic polymeric materials are being used in extensive areas because of their excellent properties. If provided with antistatic capability in addition to the mechanical properties peculiar to them, these materials can find more areas of application. That is, they can be used for parts of electronic and electric machines such as copiers and television sets which it is desired to keep free from electrostatic trouble, parts of various dustproof apparatuses, their housings, etc.

Synthetic polymeric materials have been generally provided with antistatic property (1) by kneading a water absorbable compound such as a polyalkylene oxide, antistatic agent, etc. with the polymer concerned, or (2) by coating the polymer on the surface with a surfactant, etc. Neither method provides satisfactory antistatic property, nor can it avoid such problems that rinsing or surface wiping decreases the antistatic capability, or that the ingredient contained bleeds out onto the surface, to degrade the quality of the material, and that the antistatic property is degraded by secular change.

These problems have not been solved so far. In

this situation, the inventors studied intensively for the purpose of developing intrinsically antistatic resins with permanent antistatic capability, and as a result found that said purpose can be efficiently achieved by mixing polyether ester amides, more particularly polyether ester amides of a certain type, with at least one thermoplastic resin selected from styrene based resins, polyphenylene ether resins and polycarbonate resins within a specific ratio. This finding forms the basis of the present invention.

Compositions somewhat similar to those of the present invention include those disclosed in EP-A-167824 which are prepared by adding a polyamide elastomer to a styrene based resin and/or a polyphenylene ether to enhance the wear resistance of the styrene based resin.

The invention of EP-A-167824 is intended to enhance the wear resistance of styrene based resins, and does not refer to any description or suggestion concerning their permanent antistatic property.

An object of the present invention is to provide intrinsically antistatic resins excellent in antistatic property, mechanical properties represented by impact resistance, weld strength, heat resistance, moldability and also in the appearance and gloss of moldings.

Another object of the present invention is to provide intrinsically antistatic resins excellent in the

prevention of layer exfoliation and mold corrosion.

A further object of the present invention is to provide resins suitable for housings of optical and magnetic recording media.

The intrinsically antistatic resin compositions of the present invention comprise 1 to 40 wt % of (A) a polyether ester amide and 99 to 60 wt % of (B) at least one thermoplastic resin selected from styrene based resins, polyphenylene ether resins and polycarbonate resins.

The polyether ester amide (A) as a component of the present invention can be selected from block or graft copolymers obtained by letting a polyamide forming ingredient react with a poly(alkylene oxide) glycol and a dicarboxylic acid.

Components of preferable polyether ester amides (A) in the present invention include the following. The polyamide forming ingredient can be selected from amino carboxylic acids with 6 or more carbon atoms, lactams and diamine-dicarboxylates. The aminocarboxylic acids include  $\omega$ -aminocaproic acid,  $\omega$ -aminoenanthic acid,  $\omega$ -aminocaprylic acid,  $\omega$ -aminopelargonic acid,  $\omega$ -aminocapric acid, 11-aminoundecanoic acid, 12-aminododecanoic acid, etc. The lactams include caprolactam, enantholactam, capryllactam and laurolactam. The diamine-dicarboxylates include

hexamethylenediamine-adipate, hexamethylenediamine-sebacate and hexamethylenediamine-isophthalate. Especially caprolactam, 12-aminododecanoic acid and hexamethylene-diamineadipate can be preferably used.

The poly(alkylene oxide) glycol can be selected from polyethylene glycol, poly(1,2-propylene oxide) glycol, poly(1,3-propylene oxide) glycol, poly(tetramethylene oxide) glycol, poly(hexamethylene oxide) glycol, block or random copolymers of ethylene oxide and propylene oxide, block or random copolymers of ethylene oxide and tetrahydrofuran, etc. Among them, especially polyethylene glycol can be preferably used in view of excellent intrinsically antistatic property. The number average molecular weight of the poly(alkylene oxide) glycol should be 200 to 6,000, preferably 250 to 4,000. If the number average molecular weight is less than 200, the mechanical properties of the polyether ester amide obtained are degraded, and if more than 6,000, the antistatic capability deteriorates.

The dicarboxylic acid should have 4 to 20 carbon atoms can be selected from aromatic dicarboxylic acids such as terephthalic acid, isophthalic acid, phthalic acid, naphthalene-2,6-dicarboxylic acid, naphthalene-2,7-dicarboxylic acid, diphenyl-4,4'-dicarboxylic acid, diphenoxyethanedicarboxylic acid and sodium 3-sulfo-isophthalate alicyclic dicarboxylic acids such as 1,4-

cyclohexanedicarboxylic acid, 1,2-cyclohexanedicarboxylic acid and dicyclohexyl-4,4'-dicarboxylic acid; aliphatic dicarboxylic acid such as succinic acid, oxalic acid, adipic acid, sebacic acid and decanedicarboxylic acid, etc. Especially terephthalic acid, isophthalic acid, 1,4-cyclohexanedicarboxylic acid, sebacic acid, adipic acid and decanedicarboxylic acid can be preferably used in view of polymerizability, color tone and physical properties.

A poly(alkylene oxide) glycol and a dicarboxylic acid react theoretically at a molar ratio of 1 : 1, but usually, they are supplied at a different ratio, depending on the dicarboxylic acid used.

The polyether ester composed of a poly(alkylene oxide) glycol and a dicarboxylic acid with 4 to 20 carbon atoms is a component unit of the polyether ester amide and is used in an amount of 95 to 10 wt %, preferably 80 to 30 wt %, based on the weight of the polyether ester amide. A polyether ester content of more than 95 wt % degrades the mechanical properties of the polyether ester amide, and less than 10 wt % degrades the antistatic property of the resin obtained.

The thermoplastic resin (B) as the other component of the present invention composition can be a styrene based resin. It can be selected from polystyrene, rubber modified polystyrene, styreneacrylonitrile copolymer, styrene-rubbery polymer-acrylonitrile copolymers (ABS resin, AES resin, AAS

resin) etc. Two or more of them can also be used. In these resins, the styrene and/or acrylonitrile may be partially substituted by  $\alpha$ -methylstyrene, p-methylstyrene, p-t-butylstyrene, (meth)acrylic acid or any of their ester compounds of methyl, ethyl, propyl, n-butyl, etc., unsaturated dicarboxylic acids, unsaturated dicarboxylic anhydrides, maleimide based monomers such as maleimide, N-methylmaleimide and N-phenylmaleimide, and vinyl monomers copolymerizable with styrene such as acrylamide. Especially preferably used styrene based resins are ABS resin, AES resin, AAS resin, MBS resin, etc.

The styrene based resin can preferably contain a graft (co)polymer which is composed of a rubbery polymer, and an aromatic vinyl monomer and/or a (meth)acrylic acid ester monomer, or furthermore a vinyl cyanide monomer.

The rubbery polymer should be preferably lower than 0°C in glass transition temperature, and can be selected from diene rubbers such as polybutadiene, polystyrene-butadiene and polyacrylonitrile-butadiene, polyisoprene, polychloroprene, acrylic rubbers such as polybutylacrylate, three-ingredient copolymers based on ethylene, propylene and diene, etc.

Polybutadiene and butadiene copolymer are preferred.

The aromatic vinyl monomer can be selected from

styrene,  $\alpha$ -methylstyrene, vinyltoluene, o-ethylstyrene, o-p-dichlorostyrene, etc. Styrene is preferred.

The (meth)acrylic acid ester monomer can be selected from methyl, ethyl, propyl, n-butyl, i-butyl, etc. of acrylic and methacrylic acids. Methyl methacrylate is preferred.

The vinyl cyanide monomer can be selected from acrylonitrile, methacrylonitrile, ethacrylonitrile, etc. Acrylonitrile is preferred.

As required, other vinyl monomers, for example, maleimide based monomers such as maleimide, N-methylmaleimide and N-phenylmaleimide, acrylamide, etc. can also be used.

The mixture of an aromatic vinyl monomer and/or (meth)acrylic acid ester monomer and a vinyl cyanide monomer used to prepare the graft (co)polymer should consist of 99 to 40 wt %, preferably 90 to 50 wt % of an aromatic vinyl monomer and/or (meth)acrylic acid ester monomer and 1 to 60 wt %, preferably 10 to 50 wt % of a vinyl cyanide monomer.

If the amount of the vinyl cyanide monomer is less than 1 wt %, the effect of enhancing impact resistance by adding the vinyl cyanide monomer is minimal. If more than 60 wt %, the thermal stability of the graft copolymer is remarkably lowered, to degrade the moldings in color tone.

The graft (co)polymer consisting of a rubbery



polymer and a monomer or monomer mixture should consist of 1 to 80 parts by weight, preferably 5 to 70 parts by weight of a rubbery polymer and 99 to 20 parts by weight, preferably 95 to 30 parts by weight of a monomer or monomer mixture in total 100 parts by weight of the graft (co)polymer.

If the amount of the rubbery polymer in the graft (co)polymer is less than 1 part by weight, the impact resistance of the resin composition obtained is poor, and if more than 80 parts by weight, the rubbery polymer is defectively dispersed, to impair the appearance of the moldings.

In addition to the graft (co)polymer, the graft-(co)polymer-containing composition can further contain another (co)polymer such as styrene-acrylonitrile copolymer,  $\alpha$ -methylstyrene-styrene-acrylonitrile copolymer,  $\alpha$ -methylstyrene-methyl methacrylate-acrylonitrile copolymer,  $\alpha$ -methylstyrene-acrylonitrile copolymer, styrene-methyl methacrylate-acrylonitrile copolymer, styrene-methyl methacrylate copolymer, styrene-N-phenylmaleimide-acrylonitrile copolymer,  $\alpha$ -methylstyrene-methyl methacrylate copolymer, polystyrene, polymethyl methacrylate, etc.

Preferable are a (co)polymer consisting of an aromatic vinyl monomer and/or a (meth)acrylic acid ester, a (co)polymer consisting of an aromatic vinyl monomer and/or a (meth)acrylic acid ester monomer and a vinyl cyanide monomer,

etc.

Especially a (co)polymer consisting of 100 to 40 wt %, preferably 100 to 50 wt % of an aromatic vinyl monomer and/or a (meth)acrylic acid ester monomer, and 0 to 60 wt %, preferably 0 to 50 wt % of a vinyl cyanide monomer is most preferable.

In the (co)polymer, if the amount of the aromatic vinyl monomer and/or (meth)acrylic acid ester monomer is too small, the affinity with the polyether ester amide becomes poor, and layer exfoliation tends to be caused. Therefore, the amount should be preferably 40 wt % or more.

For the purpose of the present invention, the graft (co)polymer-containing composition must contain said graft (co)polymer, and if the amount of the rubbery polymer is 1 to 40 wt % in the entire resin composition, it may contain the graft (co)polymer alone.

If the amount of the rubbery polymer is less than 1 wt %, the impact resistance of the resin composition is degraded, and if more than 40 wt %, the composition becomes undesirably soft.

The resin composition of the present invention may further contain a modified vinyl polymer containing carboxyl groups (hereinafter abbreviated as "modified vinyl polymer"). It is a polymer or copolymer with a structure obtained by polymerizing or copolymerizing one or more vinyl monomers and

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containing carboxyl groups in the molecule.

The carboxyl groups may be anhydrous carboxyl groups. The carboxyl group content is not especially limited, and can be small or large to such an extent that no degradation is caused in resin performance.

Usually, the effect of the present invention can be efficiently displayed if the modified vinyl polymer substantially contains one or more carboxyl groups on the average in the molecule.

The method for introducing carboxyl groups into the modified vinyl polymer is not especially limited. The introduction can be executed, for example, (1) by copolymerizing a vinyl monomer containing a carboxyl group or anhydrous carboxyl group such as acrylic acid, methacrylic acid, maleic acid, maleic anhydride, phthalic acid or itaconic acid, with a desired vinyl monomer, or (2) by (co)polymerizing a desired vinyl monomer, using a polymerization initiator with a carboxyl group such as  $\gamma, \gamma'$ -azobis( $\gamma$ -cyanovaleric acid),  $\alpha, \alpha'$ -( $\alpha$ -cyano)ethyl-p-benzoic acid or succinic acid peroxide and/or a polymerization degree regulating agent such as thioglycollic acid,  $\alpha$ -mercapto-propionic acid,  $\beta$ -mercaptopropionic acid,  $\alpha$ -mercapto-isobutyric acid or 2,3- or 4-mercaptobenzoic acid, or (3) by saponifying a (co)polymer of a (meth)acrylic acid ester such as methyl methacrylate or butyl acrylate, by an alkali.

The vinyl monomer used to prepare the modified vinyl polymer is not especially limited, and can be one or more selected for each purpose, for example, from aromatic vinyl monomers such as styrene and  $\alpha$ -methylstyrene, vinyl cyanide monomers such as acrylonitrile and methacrylonitrile, (meth)acrylic acid ester monomers such as methyl methacrylate and butyl acrylate,  $\alpha, \beta$ -unsaturated carboxylic acids (anhydrides) such as maleic acid and maleic anhydride, and vinyl monomers such as vinyl chloride, vinyl acetate and butadiene. Especially aromatic vinyl monomers such as styrene, (meth)acrylic acid ester monomers such as methyl methacrylate, maleimide monomers such as N-phenylmaleimide, and vinyl cyanide monomers such as acrylonitrile can be preferably used, since the resin compositions obtained become excellent in mechanical properties.

The amount of the modified vinyl polymer should be 0.1 to 20 wt %, preferably 1 to 20 wt % based on the weight of the entire composition. If the amount is less than 0.1 wt %, the effect of enhancing impact resistance by the modified vinyl polymer is minimal.

If more than 20 wt %, moldability is considerably lowered, and the moldings lose gloss on the surface.

The resin composition of the present invention may further contain an organic halogen compound, meaning thereby an

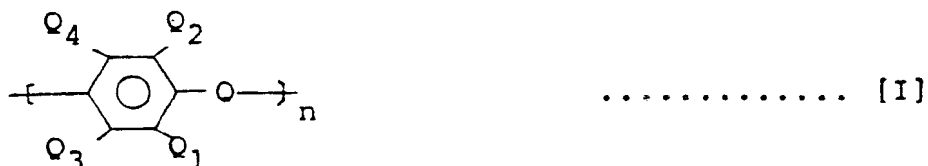
organic compound with a halogen atom in the molecule, i.e., being chlorinated or brominated, and generally known as a flame retardant, and can be concretely selected from low molecular weight organic bromine compounds such as hexabromobenzene, pentabromotoluene, hexabromobisphenyl, decabromobisphenyl, hexabromocyclodecane, decabromodiphenyl ether, octabromodiphenyl ether, hexabromodiphenyl ether, bis(pentabromophenoxy)ethane, ethylenebis(tetrabromophthalimide) and tetrabromobisphenol A, halogenated polymers and oligomers such as brominated polycarbonates (e.g., polycarbonate oligomer prepared from brominated bisphenol A), brominated epoxy compounds (e.g., a diepoxy compound prepared by the reaction between brominated bisphenol A and epichlorohydrin, a monoepoxy compound prepared by the reaction between brominated phenol and epichlorohydrin), poly(brominated benzylacrylate), brominated polyphenylene ether, brominated bisphenol A, a condensation product of cyanuric chloride and brominated bisphenol, and brominated polystyrene, and their mixtures. Among them, decabromodiphenyl ether, tetrabromobisphenol A, and brominated polycarbonate can be preferably used.

The amount of the organic halogen compound should be preferably 1 to 60 wt %, more preferably 5 to 40 wt % based on the weight of the entire composition. If the amount is less than 1 wt %, flame retardancy is insufficient, and if

more than 60 wt %, the physical properties of the composition are considerably lowered unpreferably.

As desired, the organic halogen compound can be used with an antimony compound such as antimony trioxide. It is also allowed to use zirconium oxide, zinc sulfide, barium sulfate, etc. together with antimony trioxide.

The thermoplastic resin (B) constituting the present invention composition can be a polyphenylene ether resin, which is to a homopolymer or copolymer with the following formula [I] as the unit:



(where Q<sub>1</sub>, Q<sub>2</sub>, Q<sub>3</sub> and Q<sub>4</sub> respectively independently stand for a hydrogen atom, halogen atom, hydrocarbon group, halo hydrocarbon group, hydrocarbon oxy group or halo hydrocarbon oxy group; and n is the repeated number of the monomer unit and stands for an integer of 20 or more).

Furthermore, the polyphenylene ether resin (B) can also be selected from the graft polymers obtained by graft-polymerizing an aromatic vinyl monomer to a polyphenylene ether resin.

A polyphenylene ether resin can be prepared by letting a phenol react according to the procedure described in the specification of, for example, US Patent No. 3,306,874,

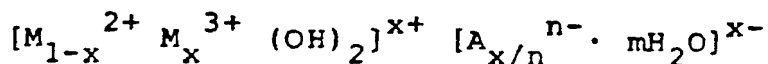
3,306,875, 3,257,357 or 3,257,358. The phenol can be selected from 2,6-dimethylphenol, 2,6-diethylphenol, 2,6-dibutylphenol, 2,6-dilaurylphenol, 2,6-dipropylphenol, 2,6-diphenylphenol, 2-methyl-6-ethylphenol, 2-methyl-6-cyclohexylphenol, 2-methyl-6-tolylphenol, 2-methyl-6-methoxyphenol, 2-methyl-6-butylphenol, 2,6-dimethoxyphenol, 2,3,6-trimethylphenol, 2,3,5,6-tetramethylphenol and 2,6-diethoxyphenol, but is not limited to these.

Any of these may be polymerized to obtain the corresponding homopolymer or may be copolymerized with another phenol, to prepare the corresponding copolymer with a different unit conforming to the above formula. For example, 2,6-dimethylphenol may be polymerized to make its polymer, i.e., poly(2,6-dimethyl-1,4-phenylene) ether, or 2,6-dimethylphenol may be copolymerized with another phenol such as 2,3,6-trimethylphenol or 2-methyl-6-butylphenol, etc., to make the corresponding copolymer such as poly(2,6-dimethyl-2-methyl-6-butyl-1,4-phenylene) ether.

The thermoplastic resin (B) constituting the present invention composition can be a polycarbonate resin. The polycarbonate resin can be an aromatic polycarbonate, aliphatic polycarbonate, or aliphatic-aromatic polycarbonate, etc. In general, it is a homopolymer or copolymer of a bisphenol such as a 2,2-bis(4-hydroxyphenyl) alkane, bis(4-hydroxyphenyl) ether or bis(4-hydroxyphenyl) sulfone,

sulfide or sulfoxide, or also a polymer of a bisphenol substituted by a halogen atom as required for a specific purpose.

The present invention composition can further contain a hydrotalcite. It is a compound represented by general formula



(where  $M^{2+}$  stands for a divalent metal such as  $Mg^{2+}$ ,  $Mn^{2+}$ ,  $Fe^{2+}$ ,  $Co^{2+}$ ,  $Ni^{2+}$ ,  $Cu^{2+}$  or  $Zn^{2+}$ ;  $M^{3+}$ , a trivalent metal such as  $Al^{3+}$ ,  $Cr^{3+}$ ,  $Co^{3+}$  or  $In^{3+}$ ;  $A^{n-}$ , an n-valent anion such as  $OH^-$ ,  $F^-$ ,  $Cl^-$ ,  $Br^-$ ,  $NO_3^-$ ,  $CO_3^{2-}$ ,  $SO_4^{2-}$ ,  $Fe(CN)_6^{3-}$ ,  $CH_3COO^-$ , oxalate ions or salicylate ion; m, the mole number of hydrate; n, charges on anion(s) A; and x, a number smaller than 1).

Above all, preferable is  $Mg_{4.5}Al_2(OH)_{13}CO_3 \cdot 3.5H_2O$  and  $Mg_{4.5}Al_2(OH)_{13}CO_3$ . Hydrotalcite compounds can be synthesized by various methods as described in US Patent Specification No. 3,539,306.

In general, a synthetic hydrotalcite is produced by coprecipitation of a cationic ingredient solution and an anionic ingredient solution. The most easily available hydrotalcite must be magnesium-aluminium hydroxycarbonate hydrate. A preferable hydrotalcite is magnesium aluminium hydroxycarbonate hydrate available under brand DHT-40 expressed as  $Mg_{4.5}Al_2(OH)_{13}CO_3 \cdot 3.5H_2O$  by the manufacturer.



The amount of the hydrotalcite used should be preferably 0.01 to 10 wt %, more preferably 0.1 to 5 wt % based on the entire composition. If the amount is less than 0.01 wt %, mold corrosion is only poorly prevented, and if more than 10 wt %, the physical properties of the composition are considerably degraded disadvantageously.

The present invention compositions can be molded to prepare housings of optical or magnetic media which can prevent optical or magnetic records from dropping out and sounds and pictures from being disturbed. For example, they can be used for optical disc jackets, video floppies, digital audio cassettes, television remote control cases, television game software, video cassettes, video discs and IC cards.

A composition of the present invention comprises 1 to 40 wt %, preferably 5 to 30 wt % of a polyether ester amide (A) and 99 to 60 wt %, preferably 95 to 70 wt % of at least one thermoplastic resin (B) selected from styrene based resins, polyphenylene ethers and polycarbonate resins. If the amount of polyether ester amide (A) is less than 1 wt %, the antistatic property of the composition is insufficient, and if more than 40 wt %, the composition becomes soft and degraded in mechanical properties.

The present invention composition may be mixed with another thermoplastic resin compatible with it, such as a polyamide, polybutylene terephthalate, polyethylene

terephthalate, vinyl chloride resin, or an elastomer like styrene-butadiene block copolymer, to be enhanced in moldability. Furthermore, an antistatic agent such as a metal sulfonate or an anionic, cationic or nonionic surfactant can be added to further enhance the antistatic capability. In addition, as required, various stabilizers such as an antioxidant, ultraviolet ray absorbent, etc., pigment, dye, lubricant, plasticizer, glass fibers, metallic filler, etc. can also be added.

#### Examples

The present invention is described more concretely below in reference to present invention examples and comparative examples. The finally obtained resin compositions were injection-molded and tested by the following methods, to measure respective physical properties.

Izod impact strength: ASTM D256-56A

Thermal distortion temperature: ASTM D648

(18.56 kg/cm<sup>2</sup> load)

Flexural elastic modulus: ASTM D790

Combustibility: Vertical burning test was executed using a 1/16" x 1/2" x 5" test piece according to UL94 Code.

MFR: Measured at 220°C and 10 kg load, using a 2 mm dia. x 8 mm nozzle.

Volume resistivity: Measured at room temperature (23°C)

and 50% RH, using a 2 mm t x 40 mm dia. disc. For the measurement, super-insulation resistance meter Model SM-10 made by Toa Electronics Ltd. was used.

Prevention of layer exfoliation of molded product: A molded product as a test piece was folded and tensile-tested, and the fracture was observed in reference to the following criterion:

- ◎ ... Very good
- ... Good
- × ... Molded product caused layer exfoliation.

Appearance of molded product: Appearance was observed in reference to the following criterion:

- ◎ ... Very good
- ... Good
- × ... Molded product was inferior in surface appearance.

In the following examples, "parts" means "parts by weight" and "%" means "wt %".

#### Reference Example

(1) Preparation of polyether ester amides (A)

A-1: Forty five parts of caprolactam, 51.6 parts of polyethylene glycol of 2000 in number average molecular weight and 4.5 parts of terephthalic acid were put into a reactor with helical ribbon stirring blades, together with 0.2 part of Irganox 1098 (antioxidant) and 0.1 part

of antimony trioxide catalyst. With the atmosphere substituted by nitrogen, the mixture was heated and stirred at 240°C for 60 minutes, to make a transparent homogeneous solution, and polymerization was executed at 260°C and 0.5 mm Hg or less for 4 hours, to obtain a consistent transparent polymer.

The polymer was discharged like guts onto a cooling belt and pelletized, to prepare a polyether ester amide (A-1) as pellets.

- A-2: Operation was executed as done to prepare (A-1), except that 60 parts of nylon 6.6 salt (AH salt), 33.8 parts of polyethylene glycol of 600 in number average molecular weight and 8.7 parts of adipic acid were used for polymerization for 4 hours, to prepare a polyether ester amide (A-2).
- A-3: Operation was executed as done to prepare (A-1), except that 30 parts of  $\omega$ -aminodecanoic acid, 14.2 parts of decanedicarboxylic acid and 58.6 parts of polyethylene glycol of 1000 in number average molecular weight were used for polymerization for 3 hours, to prepare a polyether ester amide (A-3).
- A-4: Operation was executed as done to prepare (A-1), except that 95 parts of  $\omega$ -aminodecanoic acid, 4.2 parts of polyethylene glycol of 1000 in number average molecular weight and 1.0 part of decanedicarboxylic acid were

used, to prepare a polyether ester amide (A-4).

(2) Preparation of graft (co)polymers (B)

B-1: Forty parts of a monomer mixture consisting of 55% of styrene and 45% of methyl methacrylate were emulsion-polymerized in the presence of 60 parts (in terms of solid content) of a polybutadiene latex (rubber grain size 0.25  $\mu$ m, gel content 80%).

The obtained graft copolymer was coagulated by sulfuric acid, neutralized by caustic soda, washed, filtered and dried, to prepare a powdery graft copolymer (B-1).

B-2: Ten parts of Diene NF35A (made by Asahi Kasei Ltd.) were dissolved into 90 parts of styrene, to prepare a graft polymer (B-3) by bulk polymerization.

B-3: Forty parts of a monomer mixture consisting of 70% of styrene and 30% of acrylonitrile were emulsion-polymerized in the presence of 60 parts (in terms of solid content) of the polybutadiene latex used in B-1, to prepare a powdery graft copolymer (B-3) as done to prepare (B-1).

B-4: Sixty parts of a monomer mixture consisting of 72% of methyl methacrylate, 24% of styrene and 4% of acrylonitrile were emulsion-polymerized in the presence of 40 parts (in terms of solid content) of the polybutadiene latex used in B-1, to prepare a powdery

- graft copolymer (B-4) as done to prepare (B-1).
- B-5: Eighty five parts of a monomer mixture consisting of 75% of styrene and 25% of acrylonitrile were emulsion-polymerized in the presence of 15 parts (in terms of solid content) of the polybutadiene used in B-1, to prepare a powdery graft copolymer (B-5) as done to prepare (B-1).
- B-6: Fifteen parts of a monomer mixture consisting of 70% of styrene and 30% of acrylonitrile were emulsion-polymerized in the presence of 85 parts (in terms of solid content) of the polybutadiene latex used in B-1, to prepare a powdery graft copolymer (B-6) as done to prepare (B-5).
- B-7: CPX-100L (Mitsubishi Gas Chemical Co., Inc.) was used.
- B-8: Lexan 121-111 (EPL) was used.
- (3) Preparation of (co)polymers (C)
- C-1: Fifty five parts of methyl methacrylate and 45 parts of styrene were suspension-polymerized, to prepare a copolymer (C-1).
- C-2: Seventy two parts of styrene and 28 parts of acrylonitrile were suspension-polymerized, to prepare a copolymer (C-2).
- C-3: Seventy two parts of methyl methacrylate, 24 parts of styrene and 4 parts of acrylonitrile were suspension-polymerized, to prepare a copolymer (C-3).

C-4: Fifty parts of styrene, 30 parts of N-phenylmaleimide and 20 parts of acrylonitrile were suspension-polymerized, to prepare a copolymer (C-4).

(4) Preparation of modified vinyl polymers containing carboxyl groups (D)

D-1: Forty five parts of styrene, 50 parts of methyl methacrylate and 5 parts of methacrylic acid were suspension-polymerized, to prepare a modified vinyl polymer (D-1) as beads.

D-2: Seventy parts of styrene, 25 parts of acrylonitrile and 5 parts of methacrylic acid were suspension-polymerized, to prepare a modified vinyl polymer (D-2) as beads.

D-3: Seventy parts of methyl methacrylate, 24 parts of styrene, 4 parts of acrylonitrile and 2 parts of acrylic acid were suspension-polymerized, to prepare a modified vinyl polymer (D-3) as beads.

D-4: Ninety parts of styrene and 10 parts of methacrylic acid were suspension-polymerized, to prepare a modified vinyl polymer (D-4) as beads.

D-5: Ninety parts of styrene and 10 parts of maleic anhydride were mixed in a solution, and the solvent was removed, to prepare a modified vinyl polymer (D-5).

#### Examples 1 to 15

The polyester ester amides (A), thermoplastic resins (B) and/or modified vinyl polymers (D) prepared in the

Reference Example were mixed at ratios listed in Table 1, molten, kneaded and extruded at a resin temperature of 200°C by a vented 40 mm dia. extruder, to prepare pellets.

For the thermoplastic resins (B) containing a polyphenylene ether resin and a polycarbonate resin, the other ingredients than the polyphenylene ether resin and polycarbonate resin were mixed, and molten, kneaded and extruded at a resin temperature of 200°C, to prepare pellets, and the pellets were mixed with the polyphenylene ether resin and polycarbonate resin. The mixtures were then molten, kneaded and extruded at any resin temperature of 240 to 260°C, to prepare pellets. They were molded to prepare desired test pieces by an injection molding machine.

The volume resistivity values were measured using 2 mm thick discs under the following conditions:

(1) Immediately after completion of molding, the test piece was sufficiently washed with distilled water, had the water on the surface removed, allowed to stand at 50% RH and 23°C for 24 hours.

(2) After completion of molding, the test piece was allowed to stand at 50% RH and 23°C for 200 days, washed sufficiently with distilled water, had the water on the surface removed and allowed to stand at 50% RH and 23°C for 24 hours, and measured.

Physical properties of the resin compositions were



also measured, and the results are listed in Table 2. Properties as housings of recording media were also evaluated, and the results are listed in Table 3.

Comparative Examples 1 to 8

The polyether ester amides (A) and thermoplastic resins (B) and/or modified vinyl polymers (D) prepared in the Reference Example were mixed at ratios listed in Table 1, and the physical properties of the respective resin compositions were measured as done in Example 1. The results are listed in Table 2. The properties as housings of recording media were also evaluated, and the results are listed in Table 3.

Shown as comparative examples are certain compositions which are within the invention in its broadest aspect, but in which the components are not within the preferred range.

Table 1

Resin composition												Rubbery polymer content in resin composition wt %
Polyether ester amide (A)		Thermoplastic resin (B)		Modified vinyl polymer (D)		Hydrotalcite DHT-4A-2	PB-1192	Flame retarder		Flame retarding auxiliary Sb <sub>2</sub> O <sub>3</sub> Parts		
								FR-30 Parts	Chlorinated polyethylene Parts			
Present invention example	- 1	A-1	15	B-1/C-1	20/65	-	-	-	-	-	12.0	
"	- 2	A-1	15	B-1/C-1	20/60	D-1	5	0.5	-	-	11.9	
"	- 3	A-1	15	B-3/C-2	20/60	D-2	5	0.5	-	-	10.1	
"	- 4	A-1	15	B-2	80	D-4	5	0.5	-	-	8.4	
"	- 5	A-2	30	B-5	55	D-2	15	1.0	-	-	8.1	
"	- 6	A-1	15	B-4/C-3	65/15	D-3	5	-	-	-	25.9	
"	- 7	A-3	10	B-3/C-2/C-4	24/41/20	D-2	5	0.5	-	-	14.3	
"	- 8	A-3	15	B-3/C-2	20/60	D-2	5	0.5	-	-	10.2	
"	- 9	A-1	15	B-3/C-2	25/50	D-2	10	2.0	-	-	10.8	
"	- 10	A-1	15	B-7/B-2	40/40	D-4	5	A0-20 0.3	-	-	4.0	
"	- 11	A-2	15	B-7/B-2	40/40	D-5	5	A0-20 0.3	-	-	4.0	
"	- 12	A-1	15	B-7/B-3/C-2	30/15/30	D-2	5	A0-20 0.3	-	-	9.0	
"	- 13	A-1	15	B-8/B-3/C-2	50/15/15	D-2	5	A0-20 0.3	-	-	9.0	
"	- 14	A-1	15	B-8/B-5	30/50	D-2	5	A0-20 0.3	-	-	7.5	
"	- 15	A-1	15	B-8/B-3	70/10	D-2	5	A0-20 0.3	-	-	6.0	
Comparative example	- 1	A-1	0.5	B-3/C-2	20/79.5	-	-	-	-	-	12.0	
"	- 2	A-1	50	B-3/C-2	20/15	D-2	15	0.5	-	-	11.9	
"	- 3	A-1	15	B-3/C-2	0.5/79.5	D-2	5	0.5	-	-	0.3	
"	- 4	A-4	15	B-3	80	D-2	5	0.5	-	-	47.6	
"	- 5	A-1	15	B-6/C-2	15/65	D-2	5	0.5	-	-	12.6	
"	- 6	A-1	15	B-3/C-2	20/40	D-2	25	0.5	-	-	11.9	
"	- 7	A-1	15	- /C-2	-/80	D-2	5	0.5	-	-	0	
"	- 8	A-1	15	B-3/C-2	20/60	D-2	5	0.5	-	-	10.0	

Hydrotalcite DHT-4A-2:  $Mg_4.5 Al_2(OH)_{13} CO_3$  (KYOWA CHEMICAL INDUSTRY CO., LTD.)

PB-1392: N,N Dihydroxy ethyl stearylamine (MARUBISHI PETROCHEMICAL CO., LTD.)

DBS: Sodium dodecyl benzene sulfonate (KOA CORPORATION)

FR-30: Brominated polycarbonate (MITSUBISHI GAS CHEMICAL CO., INC.)

A0-20: 1,3,5-tris(3,5-di-t-butyl-4-hydroxy-benzyl)-S-triazine-2,4,6-(1H,3H,5H)trione (ADEKA ARGUS CHEMICAL CO., LTD.)

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Table 2

Physical properties										Molded product		Combustibility
	Layer exfoliation prevention (kg·cm/cm·notch)	Flexural elastic modulus (kg/cm <sup>2</sup> )	Thermal deformation temperature (18.56 kg/cm <sup>2</sup> load) (°C)	MFR 220°C (g/10 min)	Volume resistivity		Prevention of layer exfoliation	Appearance	UL 94 code			
					Immediately after molding (Ω cm)	After being allowed to stand for 200 days (Ω cm)						
Present invention example	1	21500	91	25	3x10 <sup>10</sup>	2x10 <sup>10</sup>	○	◎	-	-		
	2	21200	90	20	7x10 <sup>10</sup>	6x10 <sup>10</sup>	◎	◎	-	-		
	3	21000	90	22	7x10 <sup>10</sup>	5x10 <sup>10</sup>	◎	◎	-	-		
	4	19800	87	28	1x10 <sup>11</sup>	8x10 <sup>10</sup>	◎	◎	-	-		
	5	18800	81	18	6x10 <sup>8</sup>	6x10 <sup>8</sup>	○	○	-	-		
	6	19100	86	6	6x10 <sup>10</sup>	5x10 <sup>10</sup>	◎	◎	-	-		
	7	21000	100	14	1x10 <sup>12</sup>	8x10 <sup>11</sup>	◎	◎	-	1/16" V-2		
	8	21100	90	25	8x10 <sup>11</sup>	7x10 <sup>11</sup>	◎	◎	-	1/16" V-0		
	9	19800	80	20	1x10 <sup>12</sup>	7x10 <sup>11</sup>	◎	◎	-	-		
	10	22300	119	(240°C) 8	8x10 <sup>10</sup>	7x10 <sup>10</sup>	○	◎	-	-		
	11	22000	121	(240°C) 8	7x10 <sup>10</sup>	7x10 <sup>10</sup>	◎	◎	-	-		
	12	21400	108	(240°C) 17	7x10 <sup>10</sup>	5x10 <sup>10</sup>	◎	◎	-	-		
	13	21500	110	(240°C) 146	9x10 <sup>10</sup>	8x10 <sup>10</sup>	◎	◎	-	-		
	14	21100	102	(240°C) 171	7x10 <sup>11</sup>	6x10 <sup>11</sup>	◎	◎	-	-		
	15	22200	120	(240°C) 83	4x10 <sup>11</sup>	1x10 <sup>11</sup>	○	◎	-	-		
Comparative example	1	25100	91	20	1x10 <sup>16</sup>	1x10 <sup>16</sup>	◎	◎	-	-		
	2	13300	59	9	3x10 <sup>8</sup>	1x10 <sup>8</sup>	x	○	-	-		
	3	26000	93	20	9x10 <sup>10</sup>	8x10 <sup>10</sup>	◎	Irregular gloss	-	-		
	4	11100	60	2	5x10 <sup>10</sup>	5x10 <sup>10</sup>	◎	x	-	-		
	5	20900	89	19	8x10 <sup>10</sup>	8x10 <sup>10</sup>	○	x	-	-		
	6	20800	92	0.6	4x10 <sup>11</sup>	4x10 <sup>11</sup>	◎	x	-	-		
	7	28000	92	18	9x10 <sup>10</sup>	8x10 <sup>10</sup>	○	Irregular gloss	-	-		
	8	22500	91	16	1x10 <sup>11</sup>	1x10 <sup>11</sup>	x	◎	-	-		

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MFR: Melt flow rate

Table 3

Molded product							
	Resin composition used	Name	Appearance	Specific gravity	Noise prevention	Cost	Others
Product evaluation example	- 1	VTR cassette	◎	1.0	◎	◎	---
	- 2	VTR cassette	○	1.0	◎	◎	---
	- 3	Television gun (case for remote control)	◎	1.0	◎	◎	
	- 4	IC card	◎	1.0	◎	◎	
	- 5	Television game software case	◎	1.0	◎	◎	
	- 6	Video floppy	○	1.0	◎	◎	
	- 7	IC card case	◎	1.1	◎	◎	
	- 8	VHD case	◎	1.1	◎	○	
	- 9	Optical disc jacket	◎	1.0	◎	◎	
Comparative product example	- 1	IC card	◎	1.0	x	◎	Low rigidity
	- 2	VHD case	○	1.0	◎	○	Low impact resistance
	- 3	VTR cassette	x	1.0	◎	◎	Low rigidity
	- 4	Optical disc jacket	x	1.0	◎	◎	
	- 5	Television gun	x	1.0	◎	◎	
	- 6	VTR cassette	x	1.0	◎	◎	
	- 7	VHD case	◎	1.0	◎	◎	Low impact resistance
	- 8						

## Note: Criteria

Appearance ...

◎ : Very good    ○ : Good    x : Very poor

Cost (though rough) ...

◎ : About the same as the cost of polycarbonate

○ : Within twice the cost of polycarbonate

x : More than twice the cost of polycarbonate

Noise prevention which corresponds to volume resistivity ...

◎ :  $1 \times 10^{12} \Omega \text{ cm}$  or less○ :  $2 \times 10^{12}$  to  $5 \times 10^{13} \Omega \text{ cm}$ x :  $6 \times 10^{13} \Omega \text{ cm}$  or more

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CLAIMS

1. Intrinsically antistatic thermoplastic resin compositions, comprising 1 to 40 wt % of a polyether ester amide (A) and 99 to 60 wt % of at least one thermoplastic resin (B) selected from styrene based resins, polyphenylene ether resins and polycarbonate resins.
2. Compositions according to claim 1, incorporating a modified vinyl polymer containing carboxyl groups in an amount of 0.1 to 20 wt % based on the weight of the entire composition.
3. Compositions according to claim 1 or claim 2, wherein the polyether ester amide (A) is formed from an aminocarboxylic acid with 6 or more carbon atoms or a lactam or a diaminedicarboxylate with 6 or more carbon atoms, a poly(alkylene oxide) glycol of 200 to 6,000 in number average molecular weight and a dicarboxylic acid with 4 to 20 carbon atoms, with the polyether ester unit accounting for 95 to 10 wt %.
4. Compositions according to any one of claims 1 to 3, wherein the thermoplastic resin (B) is a styrene based resin.
5. Compounds according to claim 4, wherein the styrene based resin contains the following graft (co)polymer:  
A graft (co)polymer obtained by graft-(co)-polymerizing 99 to 20 weight % of a monomer or monomer mixture selected from

a monomer or monomer mixture consisting of an aromatic vinyl monomer and/or a (meth)acrylic acid ester monomer, and a monomer mixture consisting of 99 to 40 wt % of an aromatic vinyl monomer and/or a (meth)acrylic acid ester monomer, and 1 to 60 wt % of a vinyl cyanide monomer, to 1 to 80 weight % of a rubbery polymer.

6. Compositions according to claim 5, wherein the rubbery polymer accounts for 1 to 40 wt % of the entire composition.

7. Compositions according to any one of claims 1 to 3, wherein the thermoplastic resin (B) is a polyphenylene ether resin.

8. Compositions according to any one of claims 1 to 3, wherein the thermoplastic resin (B) is a mixture consisting of a styrene based resin and a polyphenylene ether resin.

9. Compositions according to claim 8, wherein the mixing ratio of the styrene based resin and the polyphenylene ether resin is 99-1 wt % : 1 - 99 wt %.

10. Compositions according to any one of claims 1 to 3, wherein the thermoplastic resin (B) is a polycarbonate resin.

11. Compositions according to any one of claims 1 to 3, wherein the thermoplastic resin (B) is a mixture of a styrene based resin and a polycarbonate resin.

12. Compositions according to claim 11, wherein the styrene based resin is the graft (co)polymer specified in claim 5.

13. Compositions according to any preceding claim, containing an organic halogen compound in an amount of 1 to 60 wt % based on the weight of the entire composition.

14. Compositions according to any preceding claim, wherein a hydrotalcite is further contained in an amount of 0.01 to 10 wt % based on the weight of the entire composition.

15. Housings of optical or magnetic recording media, prepared by molding from an intrinsically antistatic resin composition according to any preceding claim.

